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Real-time Monitoring of Aerosol Generating Dental Procedures

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**Summary of the article:**

 Mehael Fennelly, Catherine Gallagher, Mairead Harding at al. aimed to quantify aerosol concentrations produced during different dental procedures under different mitigation processes in 2020. The study was carried out inside a floor to ceiling, partitioned single patient enclosure with an open doorway in a non-mechanically ventilated clinic at Cork University Dental School and Hospital and it was published in Journal of Dentistry in May 2022. (https://www.sciencedirect.com/science/article/pii/S030057122200149X).

The article talks about the analysis of aerosol concentration during tooth drilling during various mitigation processes. There are concerns among dentists about aerosol-generating procedures (AGPS), exposing both dentists and patients to the risk of contracting infectious diseases, including COVID-19. The study was conducted in a single room with floor to ceiling partitions in a clinic without mechanical ventilation at the University of Cork School and Hospital. The study was conducted on a manikin head. An experienced dental surgeon wearing a protective mask was invited to simulate dental drilling procedures. Drilling was simulated in the lower right first molar tooth, and then in the upper right first molar tooth, with an interval of 10 minutes between scaling and drilling. Aerosol concentrations were measured using an optical particle sensor (OPS) and a broadband integrated Bioaerosol Sensor (WIBS) during routine dental procedures with fixed time on the manikin's head in a split fence. Four different standardized dental procedures were repeated in triplicate for three different mitigation measures. As a result of the procedures, it was revealed that both high volume evacuation (HVE) and HVE plus local exhaust ventilation (LEV) eliminated all aerosols associated with the procedure, and the enclosure stopped the leakage of aerosols associated with the procedure. These data demonstrate that properly positioned HVES or LEVS are effective in preventing the spread through the air and the persistence of inhaled particles formed from dental AGPS. In addition, the simple housing limits the spread of aerosols outside the working area.

**Article information:**

1. Title of the article “Real-time Monitoring of Aerosol Generating Dental Procedures”

2. Authors of the study: Mehael Fennelly, Catherine Gallagher, Mairead Harding et al.

3. Article was published in Journal of Dentistry. (<https://www.sciencedirect.com/science/article/pii/S030057122200149X>)

4. Article was published in May 2022.

5. <https://pubmed.ncbi.nlm.nih.gov/35304203/> https://www.sciencedirect.com/science/article/pii/S030057122200149X

6. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Study analysis:**

**1. Type of study**

This is observational, case- control type of study. The study was carried out inside a floor to ceiling, partitioned single patient enclosure with an open doorway in a non-mechanically ventilated clinic at Cork University Dental School and Hospital In 2020.

**2. Study purpose**

**During any dental procedures, if the patient has a disease, the dentist is at risk of infection, because all procedures lead to the formation of particles in the air, representing an increased risk of transmission of infectious diseases, including COVID-19. Therefore, a study was organized that will help determine the degree of risk of dentists and their patients becoming infected with infectious diseases, including COVID-19, when undergoing aerosol-generating procedures (AGPS). Prior to the experiment, it was known that such procedures can leave bacteria in the air, as well as on the surface of various objects, which are dangerous for the body of both the doctor and the next patient, thereby being a distributor of infection. Therefore, the authors tried to answer the question: can the use of properly positioned HVE and LEV in clinics without mechanical ventilation prevent the dispersion and preservation of inhaled particles in the air during dental AGPS. If you put an additional partition, will it be able to help from the spread of infection. The authors of the article sought to quantify the concentration of aerosol formed during various dental procedures.**

**3. Experimental design**

**Aerosol concentrations were measured using an optical particle sensor and a broadband built-in bioaerosol sensor during the drilling of the dummy's teeth, at this time sensors were placed on his head that measured the concentration of bacteria in the air. For the experiment, four different dental procedures were performed, repeating them three times. During the experiment, the room was not ventilated, the windows were not opened. To simulate dental procedures, a mannequin's head was used (dental simulator – model no. PK-1 TSE, Frasaco, Germany) it was performed by an experienced dental surgeon who had a fully protective suit. Ultrasonic teeth cleaning was performed on both the upper and lower jaw for 6 minutes each with an interval of one minute. Drilling was carried out in the lower right first molar tooth, then in the upper right first molar tooth, positions for 6 minutes each, again with an interval of one minute. A 10-minute interval was observed between scaling and drilling. Each protocol was repeated three times for each type of suction used, double UV lamps were used to sterilize viruses and bacteria trapped by the filter. The first study was conducted by Mytil et al., the second by Comperda et al., the third by Holliday et al.**

**b. Each experiment was repeated three times, the time is not specified, it is said that it takes an average of 71 minutes, after the procedure, for the absolute level of PN2.5 to return to the initial level. The WIBS observed an average time of 126 minutes before the particles returned to baseline levels. The whole procedure was recorded as CSV files on a laptop connected directly. A maximum of 30,000 particles or a maximum duration of up to 3 hours are recorded in one CSV file. A total of 181 raw Excel files were collected during the measurement period.**

c) The concentration of particles in the treatment room, during ultrasonic cleaning, drilling and after dental procedures was evaluated. Every device in the office was carefully monitored. The effectiveness of various suction strategies to reduce the number of particles associated with the procedure, HVE, LEV and without suction, was compared.

Throughout the experiment, everything was recorded raw data in the form of CSV files on a laptop connected directly. All the particles, and they were registered 70,524,717, were determined during the entire time for 10 seconds, duration 6 times. Then all the data was plotted on a graph determining the presence of viruses in the room.

d)The researchers analyzed their results by arranging them in a separate section: "Statistical analysis". It has a general analysis of the study, further divided into parts: lack of suction, lever suction, inhaled particles associated with the procedure, the required time of lying under steam.

e)This work was supported by the Scientific Foundation of Ireland, the developers received a grand "New aerial surveillance of SARS-CoV2 in healthcare and airports" for the purchase of equipment for the university.

**4. Result:**

a) Both high volume evacuation (HVE) and HVE plus local exhaust ventilation (LEV) destroyed all aerosols associated with the procedure, and the enclosure stopped the leakage of aerosols associated with the procedure. Aerosols recorder by OPS and WIBS were 84 and 16 times higher than background levels when drilling tooth 16 with the designation FDI (UR6) and 11 and 24 times higher when drilling tooth 46 with the designation FDI (LR6), respectively. Ultrasonic scaling around the full lower arch (CL) or full upper arch (CU) did not lead to the formation of detectable aerosols when using emollients. Without mitigation, the highest concentration of inhaled particles during procedures observed by WIBS and OPS was during drilling LR6 (139/cm3) and UR6 (28/cm3), respectively. Brief aerosol bursts were recorded during drilling procedures using HVE, this did not happen with LEV, which suggests that LEV provides protection against operator errors. There was a change in the required time of occurrence of steam (49-280 minutes) without impact mitigation, while when using impact mitigation, the particles did not remain in the air.

b) Statistically significant were: high volume pumping (HVE) and HVE and local exhaust ventilation (LEV) destroyed all aerosols associated with the procedure, and stopped the leakage of aerosols associated with the procedure. Therefore, such measures will be sufficient to protect the dentist and the patient from various infections, including COVID-19. The following results may be insignificant: the use of RMU and DUM during the drilling procedure showed that both drugs can be applied. This data demonstrates that correctly positioned HVE or LEV is effective in preventing airborne spread and persistence of inhalable particles originating from dental AGPs. Additionally, a simple enclosure restricts the spread of aerosols outside of the operating area. Therefore, such measures will be sufficient to protect the dentist and the patient from various infections, including COVID-19.

**5. Conclusion:**

This study demonstrated the usefulness of appropriately positioned HVE during dental treatment of AGP. Fences of buildings and premises further reduce the content of solid particles in the air. In the absence of HVE, airborne particles were identified in the size range of the respiratory tract. This is critically important in the context of the COVID-19 pandemic, since the inhalation of such particles released during the treatment of an infected person it can lead to the transmission of the virus to dental staff and patients. From this article, understand that the riskiest procedure for aerosol formation is drilling, and when performing this procedure, the highest precautions must be observed. This article has a list of authors: Mehael Fennelly, Catherine Gallagher, Mairead Harding, Stig Hellebust, John Wenger, Niall O'Sullivan, David O'Connor, Michael Prentice. The WIBS device can provide additional characterization of airborne particles using fluorescence spectroscopy, and the use of this type of device in future patient studies can help determine the source and likely infectivity of bioaerosols associated with the procedure. There is no study limitation were listed.

**6. Impression:**

 I think this study is important because dental professionals are at risk of infections every day. One of the main criteria of a dental professionals’ work is the safety of both the clinicians and the patient. Even if there is no mechanical ventilation in the room, it is possible to use properly positioned HVE and LEV were completely effective in preventing the spread of airborne droplets and resistance of inhaled particles formed from dental AGPS. An experienced dentist took part in this experiment, I had a question, if the dentist is a beginner, then can the experimental data correspond to his work, or do it need to conduct additional research, there was a dummy as an experimenter. And if this is a patient who really is a carrier of a viral infection, in particular COVID-19, will the experimental data match for him as well?